

Natural Gas and Electricity Costs
Office of Sustainability
August 21, 2018

Overview

- Current City of Austin Energy Code **requires** the usage of natural gas for residential water heating where available.
- Council Adopted a target of net zero GHG emissions by 2050
 - This means near ZERO usage of gasoline, diesel, natural gas, and coal
- **Technology lock-in** is a form of economic path dependence whereby the market selects a technological standard and because of network effects the market gets locked-in or stuck with that standard even though market participants may be better off with an alternative.
- In the past, using electricity for heating air and water emitted more carbon and was more expensive than using natural gas. Due to Austin Energy's shift to renewable energy and efficiency advances in heat pumps, this is all changing.

Impetus of Project

- Resource Management Commission and Joint Sustainability Committee Member requested analysis on this topic.
- Project Goal: Gain insight into emissions and cost implications of gas versus electricity in single family residential homes.

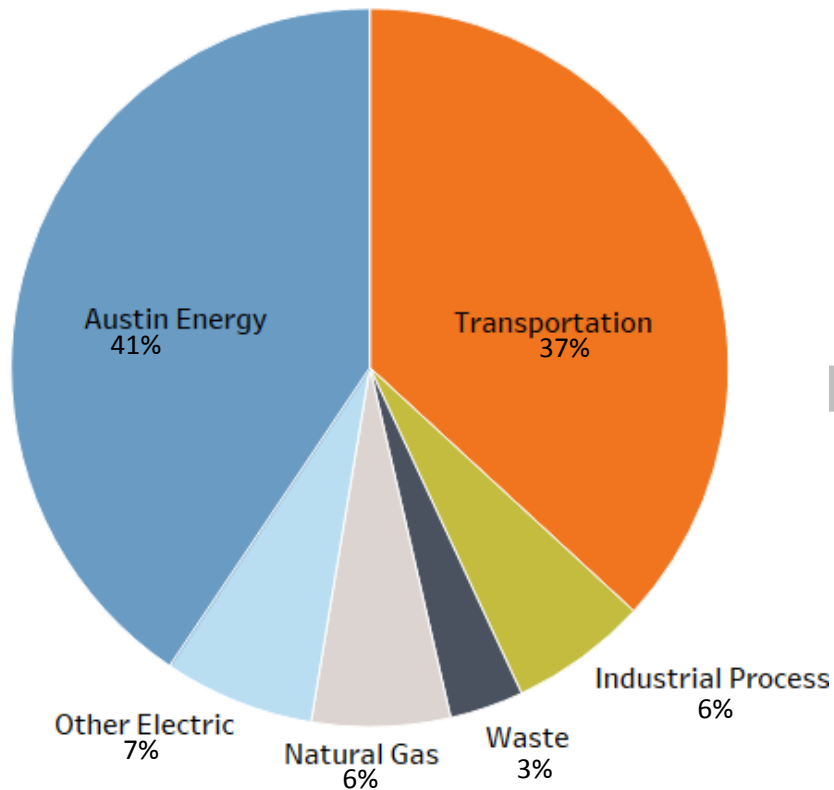
This is an Emerging Area of Study

- Rocky Mountain Institute – The Economics of Electrifying Buildings Now – June 2018
 - With an increasingly low-carbon electric grid comes the opportunity to meet nearly all our buildings' energy needs with electricity, eliminating direct fossil fuel use in buildings and making the gas distribution system—along with its costs and safety challenges obsolete.
 - Stop supporting the expansion of the natural gas distribution system, including for new homes.
- American Gas Association – Implications of Policy Driven Residential Electrification – July 2018
 - The GHG emissions are very small – 4% of the total
 - The switch from gas will be expensive for customers

Emissions

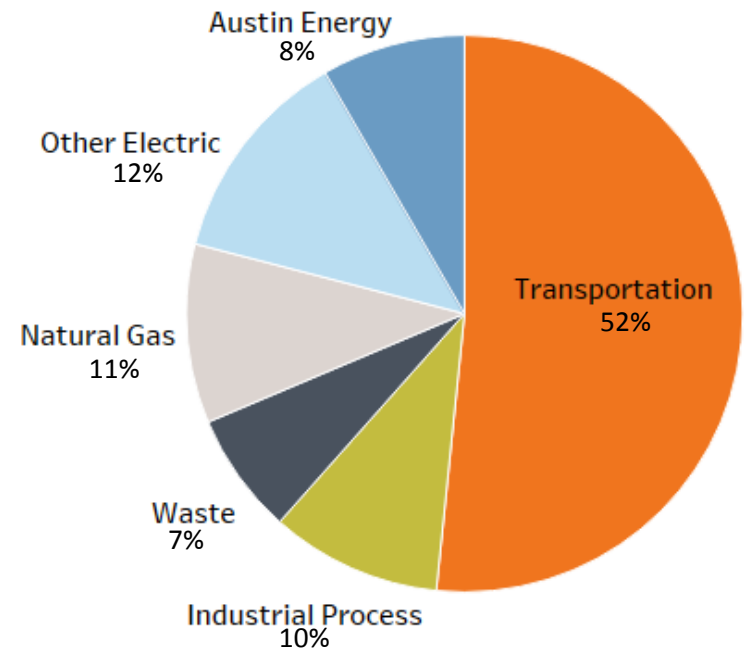
Austin Community GHG Inventory

2016



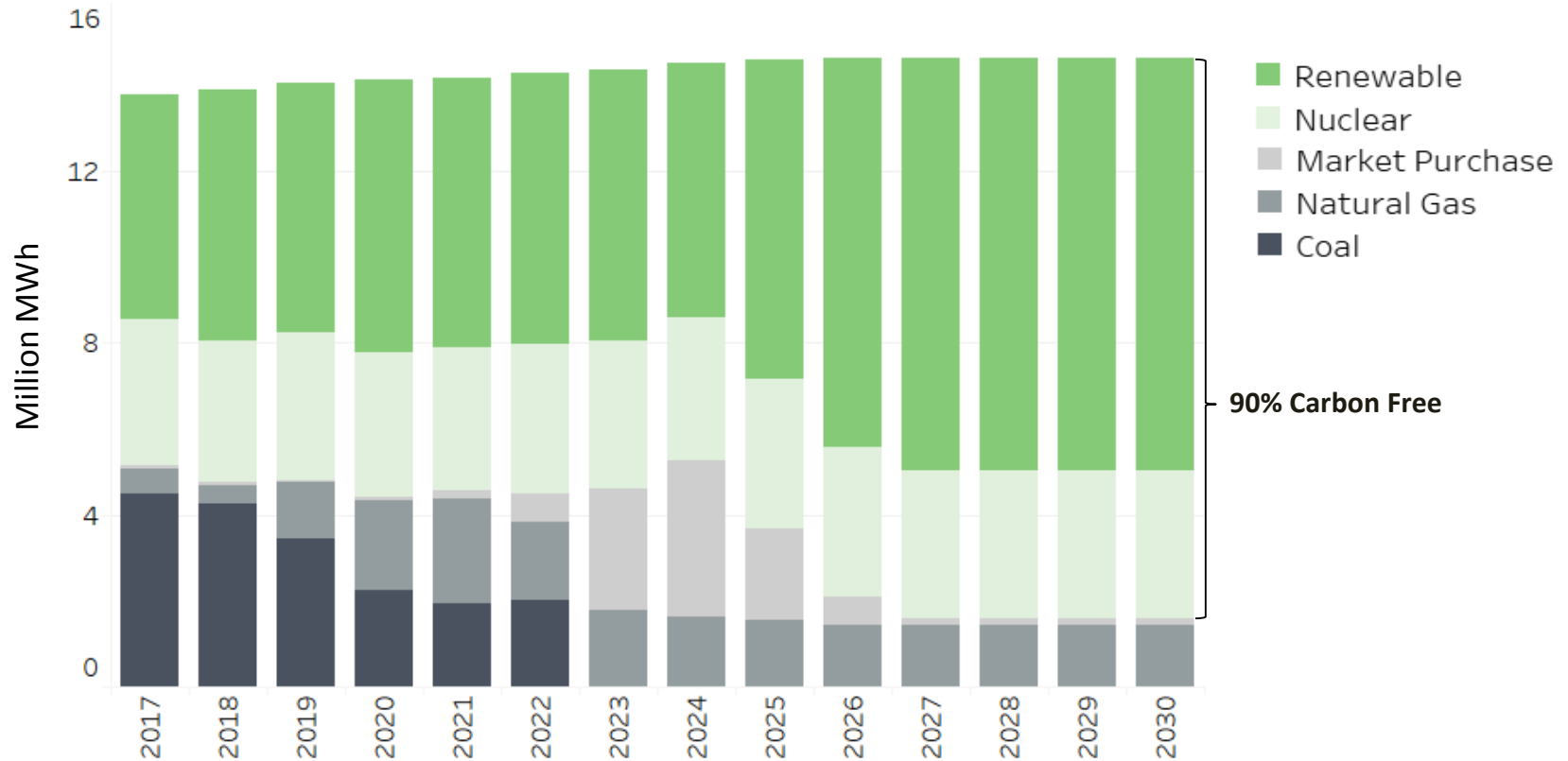
13.5 Million Metric Tons CO₂e

2030



8.0 Million Metric Tons CO₂e

Projected AE Load and Offset by City Generation Resources



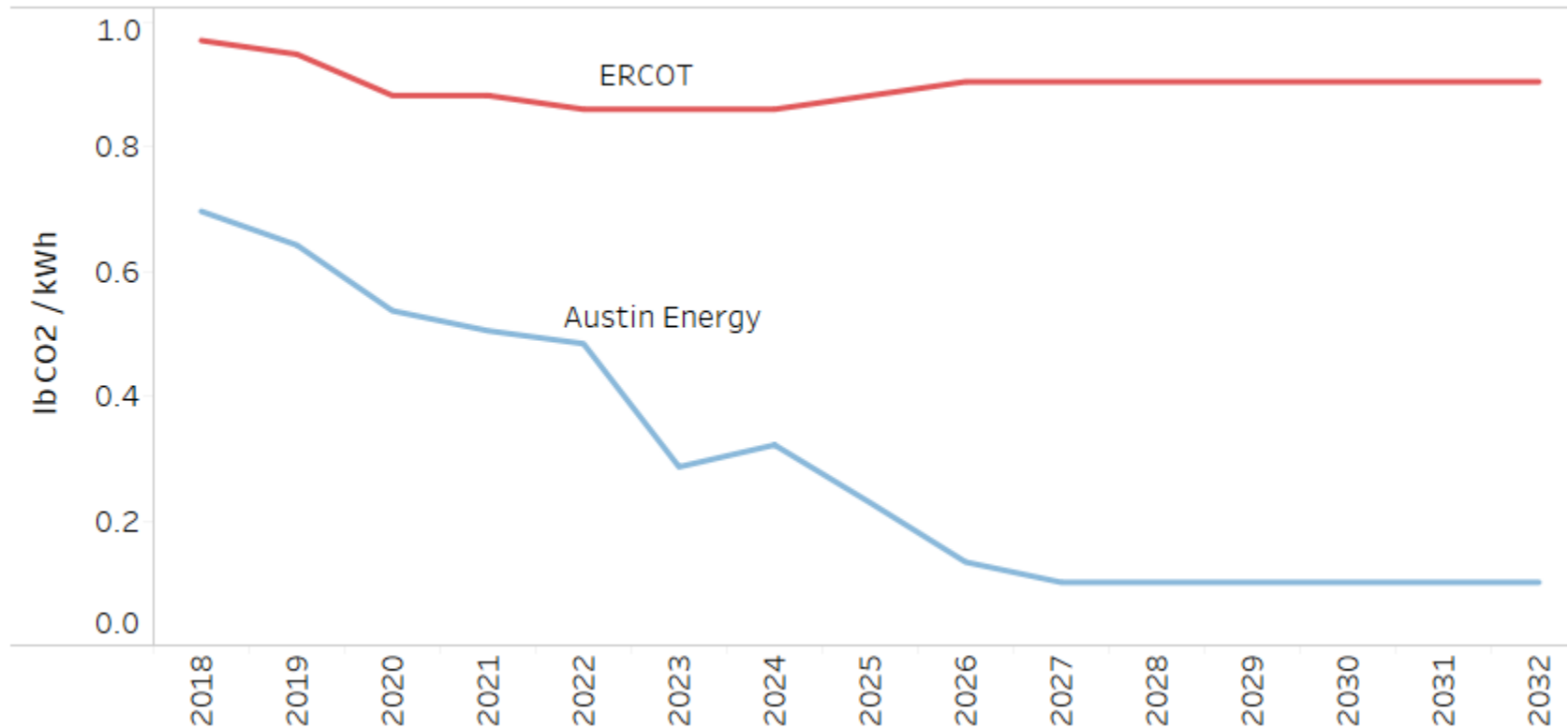
2017 Council Adopted Austin Energy Generation Plan Highlights

- Reach 65% renewable energy by 2027
- Target retirement of selected Decker units in 2020 – 2021
- Target retirement of Fayette Power Project beginning in 2022

Emission Factor Calculation

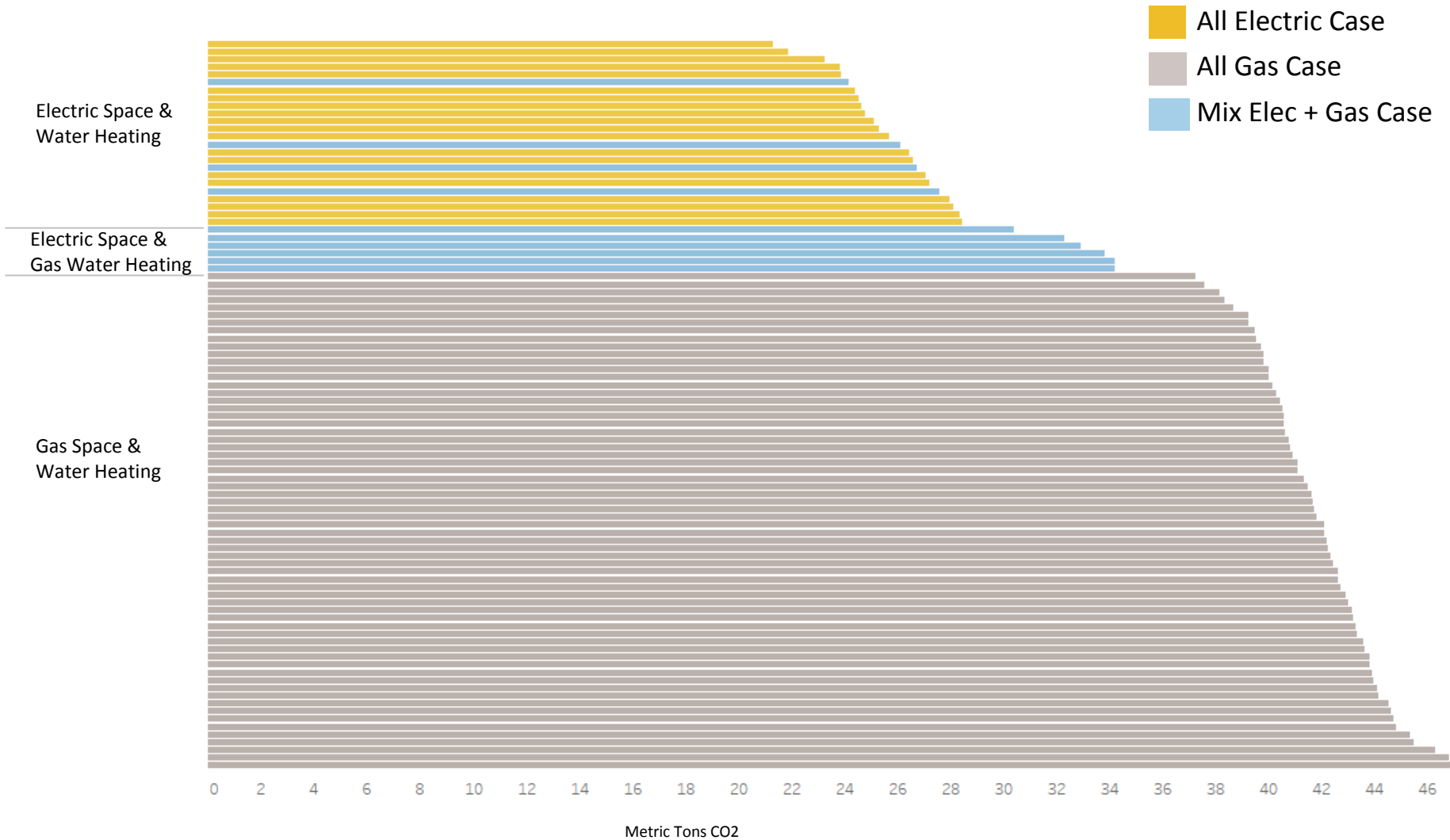
- At any given time electric load is served by the diverse mix of resources online throughout the ERCOT grid that includes gas, coal, nuclear and renewable resources;
- Austin Energy serves customer load and manages its own generation resources that provide energy to the ERCOT grid on behalf of its customers;
- Austin Energy has invested in a generation resource mix that is less carbon intense than the ERCOT grid as a whole, and considers the environmental attributes of its own resources to be for the benefit of its own customers
- Austin Energy therefore calculates the carbon footprint of customer energy use based on their own fleet-averaged carbon emissions

Electricity Carbon Intensity



2018 – 2032 GHG Emissions

AE Carbon Intensity



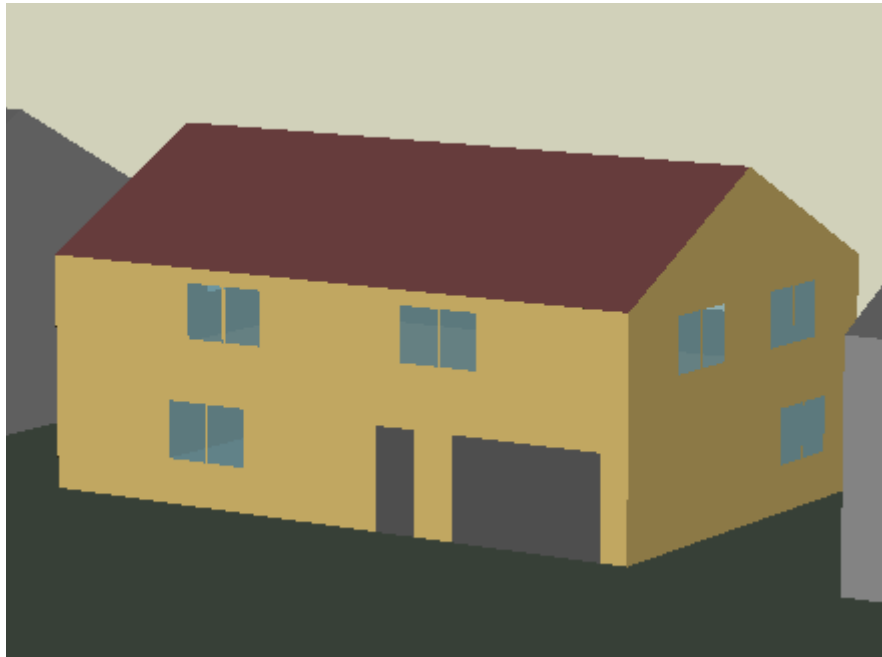
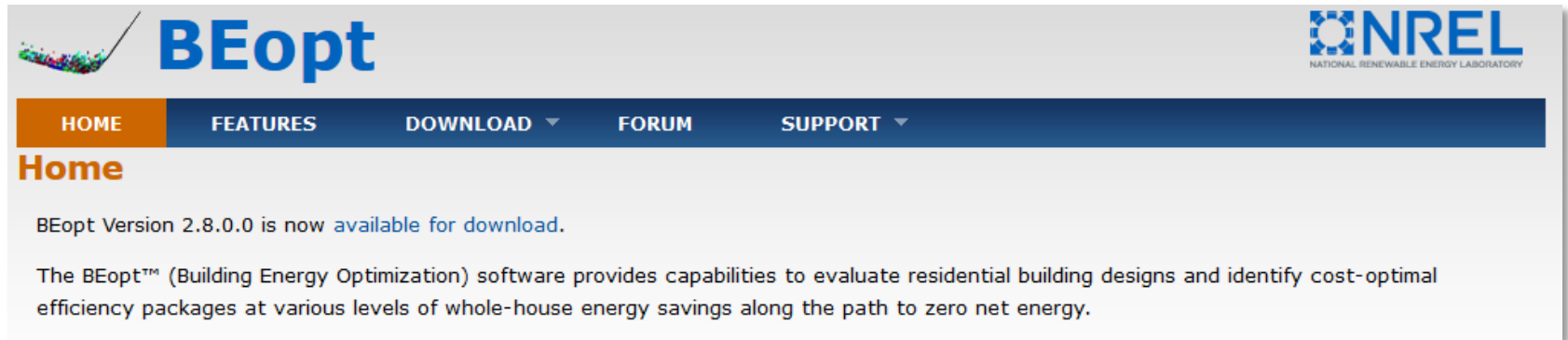
Emissions Analysis Takeaways

- Achieving the Austin Energy 2027 Generation Plan will dramatically lower Austin Energy GHG emissions and therefore customer electricity emission factors.
- New heat pump technology is very energy efficient.
- Over a 15 year lifetime, a code compliant all-electric new single family home using Austin Energy electricity will create less GHG emissions than the comparable home with natural gas space and water heating equipment.

How do capital and operating costs compare for new construction single family residential homes with gas + electric versus electric only?

Cost Analysis

Modeling Assumptions



Model parameters based on the latest COA Energy Code

- 4 bed 2 bath 2475 SF
- Fiber-Cement Siding
- Insulation
 - R-19 Wall (Fiberglass Batt)
 - R30 Ceiling (Cellulose)
- Asphalt shingles
- Window U-Value = 0.35
- Window Area 324 SF
- 7.5% Leakage R-8 ducts
- Heat Set point 71 / Cool Set point 76
- Austin climate data
- 15 year project analysis period

Appliances Examined

84 unique house combinations of appliances were examined

Appliance Category	Electric Case	Natural Gas Case
Space Conditioning	SEER 14 / HSPF 8.2 SEER 15 / HSPF 8.5 SEER 17 / HSPF 8.7 SEER 19 / HSPF 9.5 SEER 22 / HSPF 10.0	SEER 14 AC 80% Furnace SEER 15 AC 90% Furnace SEER 17 AC 95% Furnace SEER 24.5 AC 98% Furnace
Water Heating	Electric Tank (92%) Electric Tankless (99%) Heat Pump - 50 Gal Heat Pump - 80 Gal	Natural Gas Tank (59%) Natural Gas Premium Tank (67%) Natural Gas Tankless (82%) Natural Gas Tankless Condensing (96%)
Cooking	Electric Range	Natural Gas Range
Clothes Dryer	Electric Dryer	Gas Dryer

Methods and Assumptions

Energy Modeling

- NREL's BEopt models hourly building energy consumption based on hundreds of input parameters
- BEopt modeling program produced appliance specific energy outputs for the modeled home inputs.
- Comparisons include all system energy. The natural gas case includes electricity consumption when it is required.

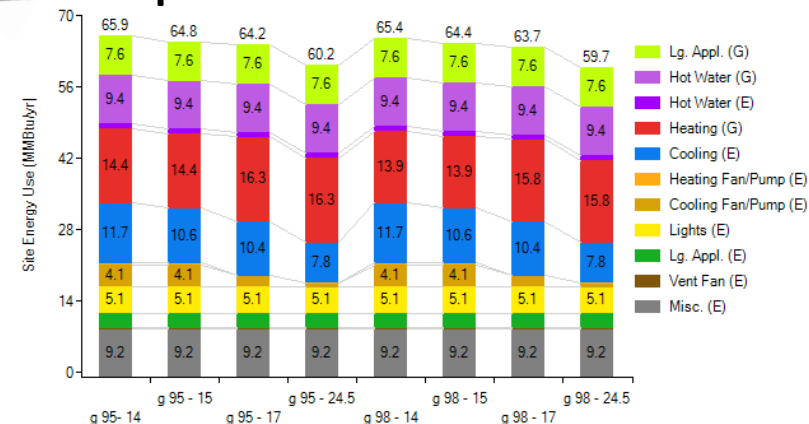
Inputs

The screenshot displays the BEopt software interface with various input categories and their corresponding options:

- Thermal Mass:** Carpet (1, 2, 3, 4, 5, 6), Floor Mass (1, 2, 3), Exterior Wall Mass (1, 2, 3, 4, 5, 6, 7), Partition Wall Mass (1, 2, 3, 4, 5, 6, 7), Ceiling Mass (1, 2, 3, 4, 5, 6, 7).
- Windows & Doors:** Window Areas (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11), Windows (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24), Interior Shading (1, 2, 3, 4, 5, 6, 7), Door Area (1, 2, 3, 4), Doors (1, 2, 3), Eaves (1, 2, 3, 4), Overhangs (1, 2, 3, 4, 5, 6, 7).
- Airflow:** Air Leakage (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15), Mechanical Ventilation (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11), Natural Ventilation (1, 2, 3, 4).
- Space Conditioning:** Central Air Conditioner (1, 2, 3, 4, 5, 6, 7, 8, 9, 10), Room Air Conditioner (1, 2, 3, 4, 5, 6, 7, 8, 9, 10), Furnace (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23), Boiler (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20), Electric Baseboard (1, 2), Air Source Heat Pump (1, 2, 3, 4, 5, 6, 7, 8, 9), Mini-Split Heat Pump (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21).
- Building Settings:** EPW Location (USA_TX_Austin.722540_TMY2.epw), Terrain (Suburban), Natural Gas Hookup (checked).
- Economics:** Project Analysis Period (15 years), Inflation Rate (2.0 %), Discount Rate (Real) (3.0 %).
- AC Options Table:**

Option	Compressor	Cycling [frac]
1) None		
2) SEER 13	1 Stage	0.07
3) SEER 14	1 Stage	0.07
4) SEER 15	1 Stage	0.07
5) SEER 16	1 Stage	0.07
6) SEER 16 (2 Stage)	2 Stage	0.11
7) SEER 17	2 Stage	0.11
8) SEER 18	2 Stage	0.11
9) SEER 21	2 Stage	0.11
10) SEER 24.5	Var. Speed	0.25

Outputs



Cost Modeling

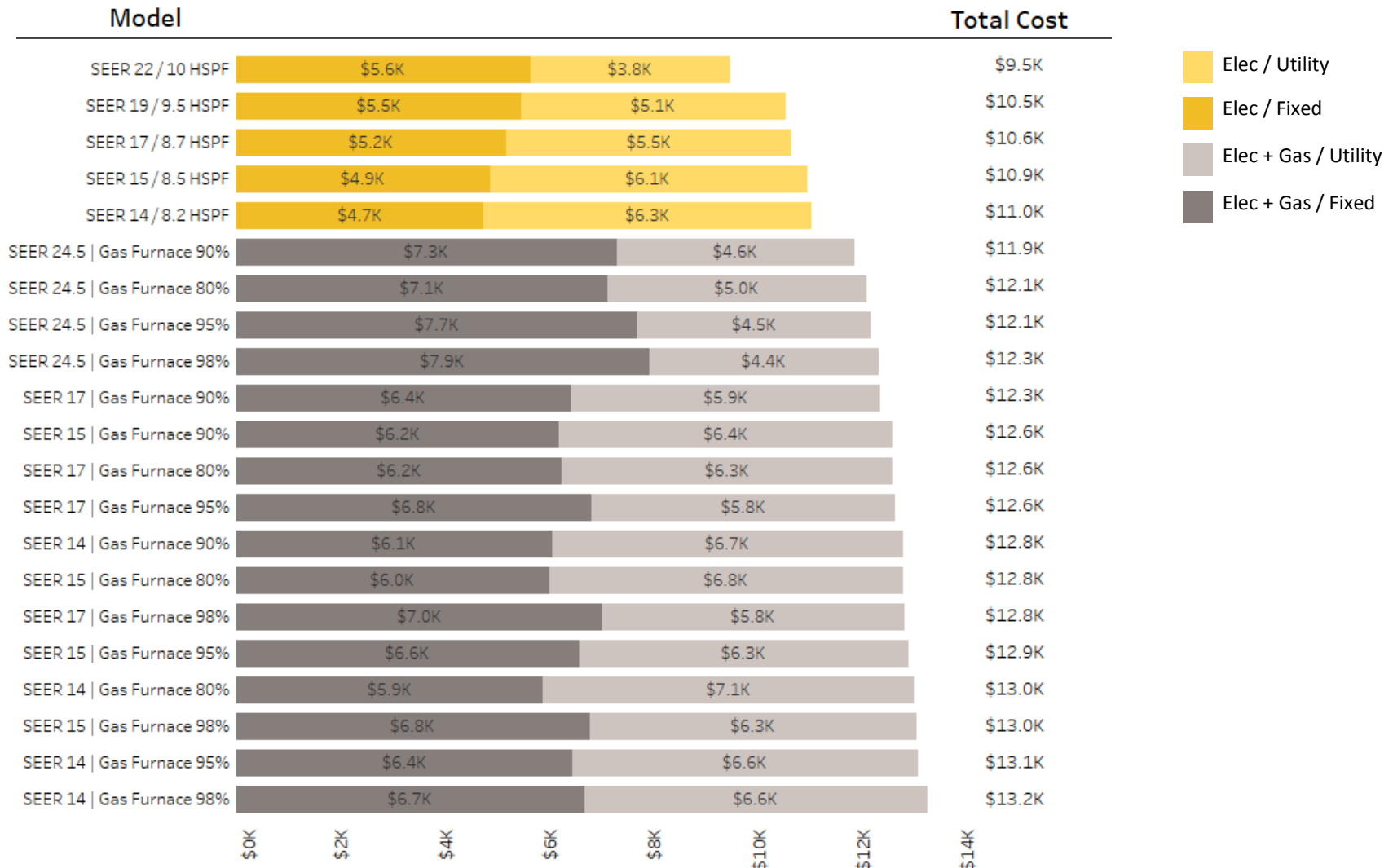
Fixed Costs

- BEopt models net present cost over the analysis period using designated appliance lifetime and replacement costs

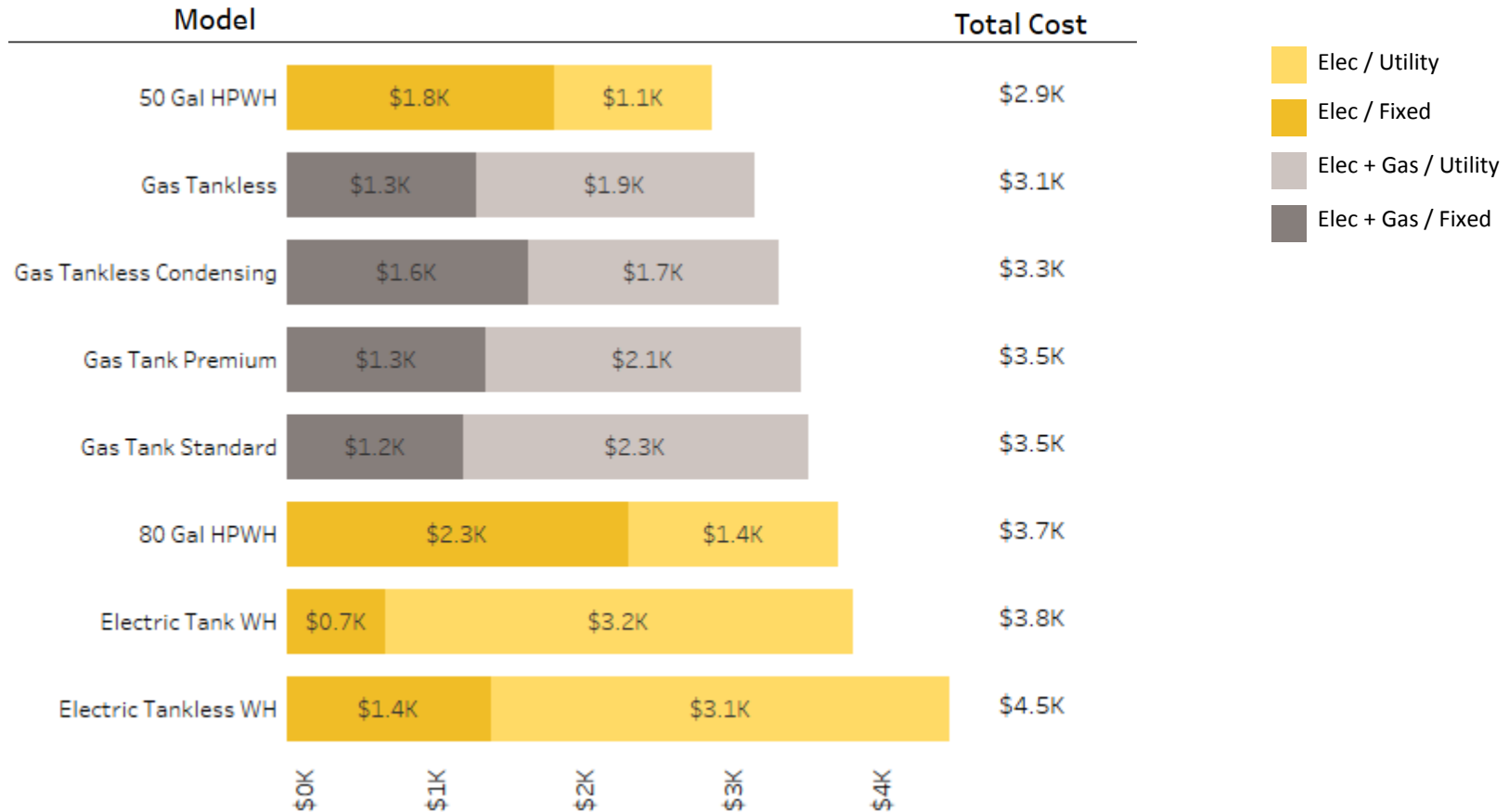
Utility Costs

- Energy outputs in kWh of electricity and therms of natural gas were priced using Austin Energy and Texas Gas Service's rate structures.
- Current yearly pricing was extended without inflation and the Net Present Value was calculated over the 15 year timeframe with a 3% real discount rate.
- An entire home's energy use was modeled for a year to account for tiered rate structures and seasonal variance in pricing.
- Individual appliance costs were then derived from the annual home utility cost.
- Each appliance's yearly cost depends on the other appliances in the house. The median value across all modeled homes was used in the final analysis.

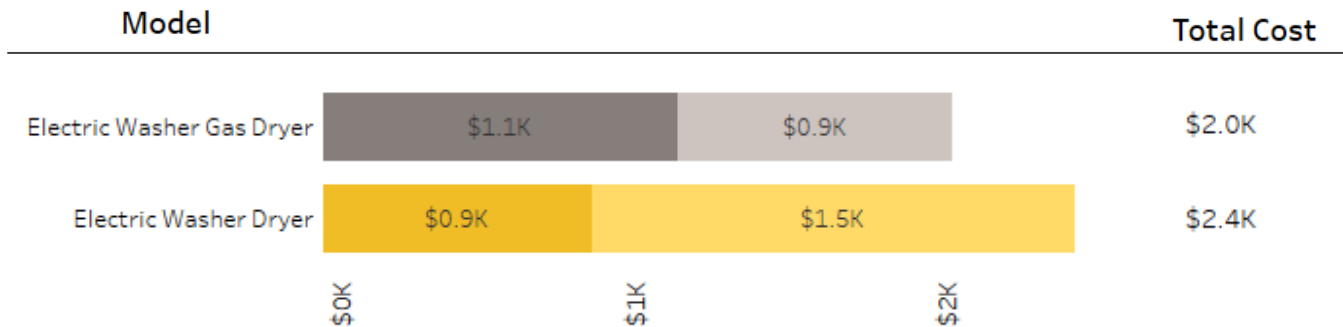
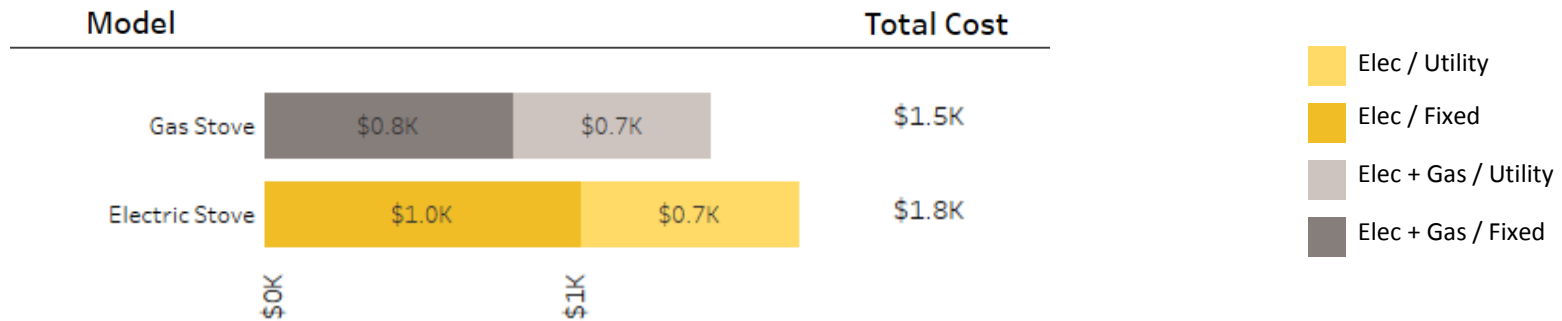
Space Conditioning 15 Year Cost



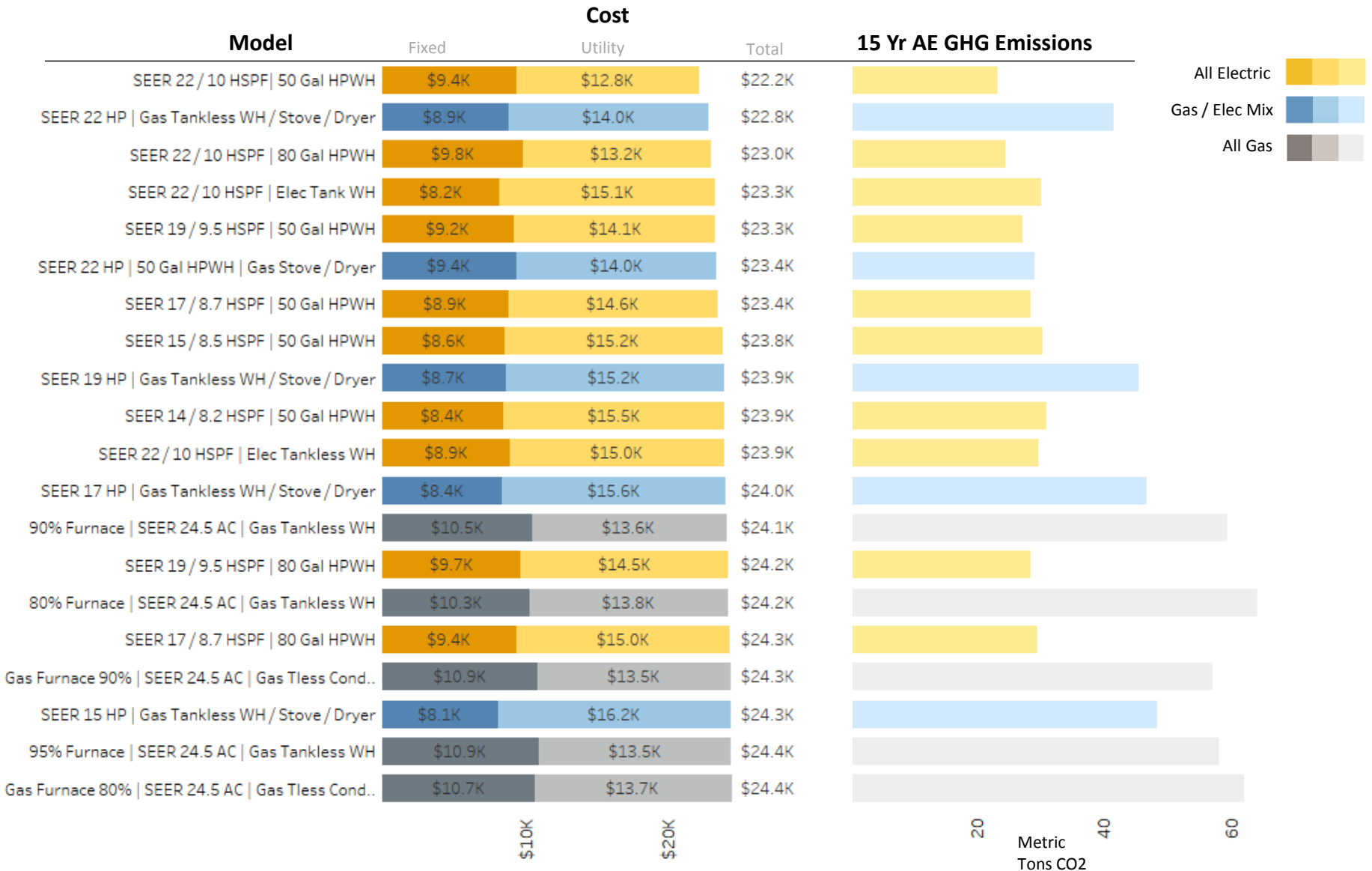
Water Heating 15 Year Cost



Stove / Dryer Appliance 15 Year Cost



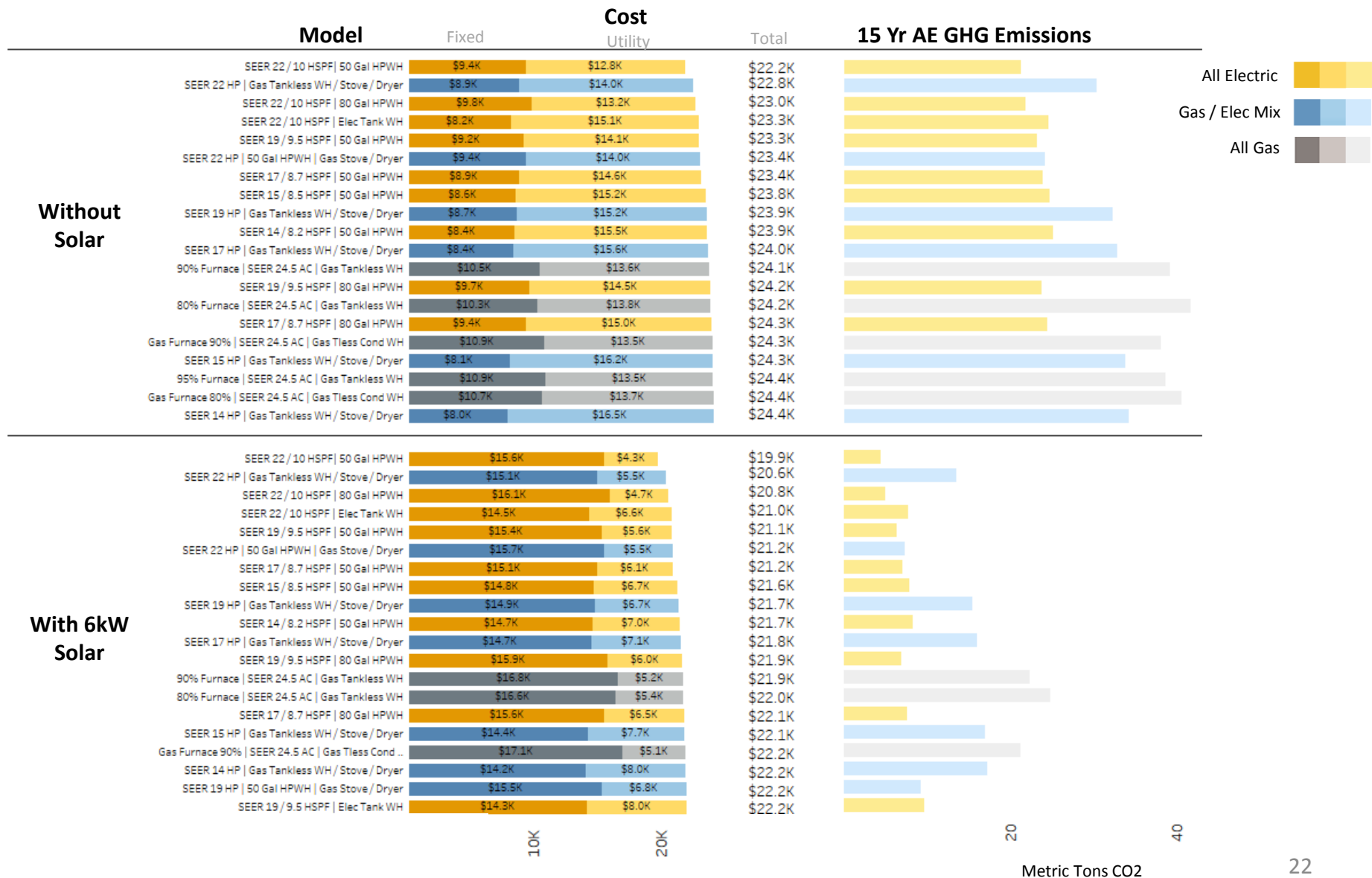
Whole House 15 Year Cost (Top 20)



Solar PV Assumptions

- 6kW Solar PV System modeled for all homes
- 15 Year analysis period
- 30% Federal Solar Investment Tax Credit and \$2500 Austin Energy rebate are included
- \$ 0.085 Value of Solar used for the entire 15 year analysis period
- All cash flows discounted to NPV at 3%

Solar Analysis



Takeaways

- Over a 15 year lifetime, a code compliant all-electric new single family home using Austin Energy electricity will create less GHG emissions than the comparable home with natural gas space and water heating equipment.
- Over a 15 year lifetime, a code compliant all-electric new single family home can have lower equipment plus utility costs than the comparable home using natural gas and electricity.
- Factors not included in this analysis:
 - Local equipment costs
 - Gas / electric connection infrastructure costs
 - Additional scenarios including different size homes and higher electricity usage
 - Retrofitting existing buildings
 - Multi-family and commercial buildings and construction trends